Model
DA-10
CONTROL SELECTOR

IN ALL CORRESPONDENCE WITH THE FACTORY BE SURE TO INCLUDE THE FOLLOWING INFORMATION:

EQUIPMENT MODEL NUMBER

SERIAL NO. 488

LING NO. 41850

LING ELECTRONICS Division
LING-TEMCO-VOUGHT, INC.
1515 So. Manchester Avenue
Anaheim, California

TABLE OF CONTENTS

SECTION 1 DESCRIPTION AND CHARACTERISTICS

Paragraph		*Page*
1-1	General	1
1-2	Purpose	1
1-3	Specifications	1

SECTION 2 OPERATION

2-1	Installation	2
2-2	Operating Procedures	3

SECTION 3 PRINCIPLES OF OPERATION

3-1	Introduction	3
3-2	Circuit Description	4
3-3	DA-10C Modification	5

SECTION 4 MAINTENANCE

4-1	Analysis	5
4-2	Trouble Shooting	6
4-3	Test Equipment	8
4-4	Testing and Calibration	8
4-5	Adjustments	10
4-6	Cleaning	10
4-7	Other Difficulty	10

LIST OF ILLUSTRATIONS

SECTION 2

Figure		*Page*
2-1	Model DA-10 Control Selector, Dimensional Drawing	2
2-2	Model DA-10 Control Selector, Front View	3

SECTION 3

3-1	Model DA-10 Control Selector, Block Diagram	4

SECTION 4

4-1	Model DA-10 Control Selector, Bottom View	7
4-2	Model DA-10 Control Selector, Voltage and Resistance Diagram	7

LIST OF TABLES

SECTION 1

Table		*Page*
1-1	Tube Complement	1

SECTION 2

2-1	Electrical Connections	2
2-2	Front Panel Controls, Indicators and Meters	3

SECTION 4

4-1	Trouble Shooting	6
4-2	Model DA-10 Control Selector, Voltage Checks	8
4-3	Model DA-10 Control Selector, Resistance Checks	8

SECTION 1
DESCRIPTION AND CHARACTERISTICS

1-1. GENERAL

a. The Ling Electronics Model DA-10 is a dual channel transfer unit designed to switch control from two inputs to one output. The two models of the DA-10 are: the DA-10B; which switches control to the larger of the two input signals; and the DA-10C, which switches control to the smaller of the two input signals. Normally, the input signals are proportional to displacement or acceleration of the shaker. The DA-10 is normally used as part of a servo system such as the Ling Model S-11 or S-14.

b. This manual is written to provide information for both the DA-10B and the DA-10C. The information that applies to both units will be noted as the DA-10.

1-2. PURPOSE

The DA-10 selects the controlling signal to which the servo system must respond, when used as a part of a servo system for vibration testing. Switch-over to the larger of the two signals is automatic on the DA-10B. The DA-10C switches automatically to the smaller of the two signals.

1-3. SPECIFICATIONS

All components of the DA-10, including the power supply, are contained in one rack mounting chassis. All necessary controls and indicators are located on the front panel.

Power requirements . . . . . 115 vac, 60 cps, 50 va

Input impedance . . . . . 1.0 megohm

Signal input (two inputs) . . . . . 0.7 v rms (nominal) normally supplied from a Ling M-14, S12, 225 or a similar device

Output Signal . . . . . 0.7 v rms (nominal) either displacement or acceleration

Frequency range . . . . . 5 - 2000 cps

Weight . . . . . Approximately 5 pounds

TABLE 1-1 TUBE COMPLEMENT

REFERENCE SYMBOL	TYPE	FUNCTION
V1	6AN8	Voltage amplifier, D channel
V2	6AN8	Voltage amplifier, G channel
V3	6H6	Diode, D channel
V4	6H6	Diode, G channel
V5	2050	Thyratron that controls the energizing of the relay
V6	5Y3	Rectifier

SECTION 2
OPERATION

2-1. INSTALLATION (see figure 2-1)

a. The DA-10 is shipped with all tubes in place and ready to operate. A visual inspection should be made after unpacking for evidence of shipping damage, loose knobs, tubes or components.

b. The DA-10 is available as a separate equipment item for other uses or for expansion of existing servo systems to multiple level operation. In these cases, initial preparation consists of mounting the unit in a suitable rack, and wiring for operation.

c. The DA-10 is designed for rack mounting and is installed according to the instructions applicable to the system with which it is to be used. Connections are made to a terminal board on the rear of the chassis. (see table 2-1)

TABLE 2-1 ELECTRICAL CONNECTIONS

TERMINAL NO.	CONNECTION
1	Chassis ground
2	Circuit ground
3	115 vac, 60 cps input
4	115 vac, 60 cps input
5	Circuit ground
6	D input
7	G input
8	Output
9	To external circuit
10	To external circuit

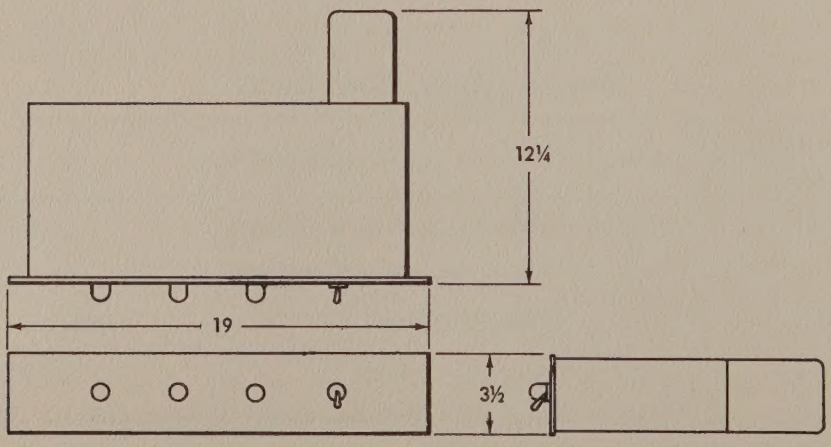


Fig. 2-1 Model DA-10 Control Selector, Dimensional Drawing

TABLE 2-2 FRONT PANEL CONTROLS, INDICATORS AND METERS (see figure 2-2)

PANEL MARKING	DESIGNATION	DESCRIPTION AND FUNCTION
POWER	IS1	INDICATOR. Indicates power switch S1 is ON and power is applied to the unit.
CONSTANT ACCELERATION	IS2	INDICATOR. Indicates when the acceleration signal is in control of the servo.
CONSTANT DISPLACEMENT	IS3	INDICATOR. Indicates when the displacement signal is in control of the servo.
BALANCE	R27	POTENTIOMETER. Adjusts for equal balance level (cross over) between the incoming signals.
ON	S1	TOGGLE SWITCH. Controls the application of power to the DA-10.

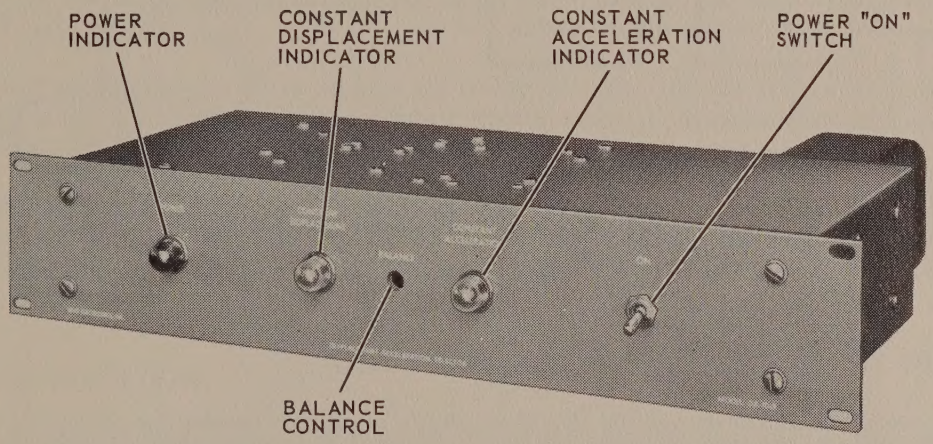


Fig. 2-2 Model DA-10 Control Selector, Front View

2-2. OPERATING PROCEDURES

The DA-10 is started by turning the toggle switch ON. Allow approximately five minutes for the unit to warm up. With S1 off, the control selector is automatically bypassed and the output is connected to the G input. When S1 is ON, the DA-10B output will transfer to the D input when the D signal exceeds the G signal. Since the DA-10C selects the smaller of the two signals, the output will be transferred to the G input when the D signal is the larger of the two.

SECTION 3
PRINCIPLES OF OPERATION

3-1. INTRODUCTION (See figure 3-1)

a. The Ling Model DA-10B Control Selector is a switching device that automatically selects the larger of two input signals, one of which will be the controlling signal for a servo system used in vibration testing. The two input signals are normally proportional to displacement or acceleration; they may also be proportional to velocity, depending on the particular type of servo or shaker pickup being used. Several DA-10 units may be used in multiple level servo systems. The DA-10 consists of two identical voltage amplifiers, two diode rectifiers (producing positive

and negative signals proportional to the peak-to-peak value of the input signals) and a thyratron operated relay. Signals produced are positive on the D channel and negative on the G channel.

b. In the usual servo applications, as frequency changes from a low to a high value, the displacement remains constant and the acceleration increases to some maximum level; thereafter the acceleration remains constant and the displacement decreases. Thus the DA-10 switches, at the crossover point, whenever the signal from one of the two channels exceeds the other.

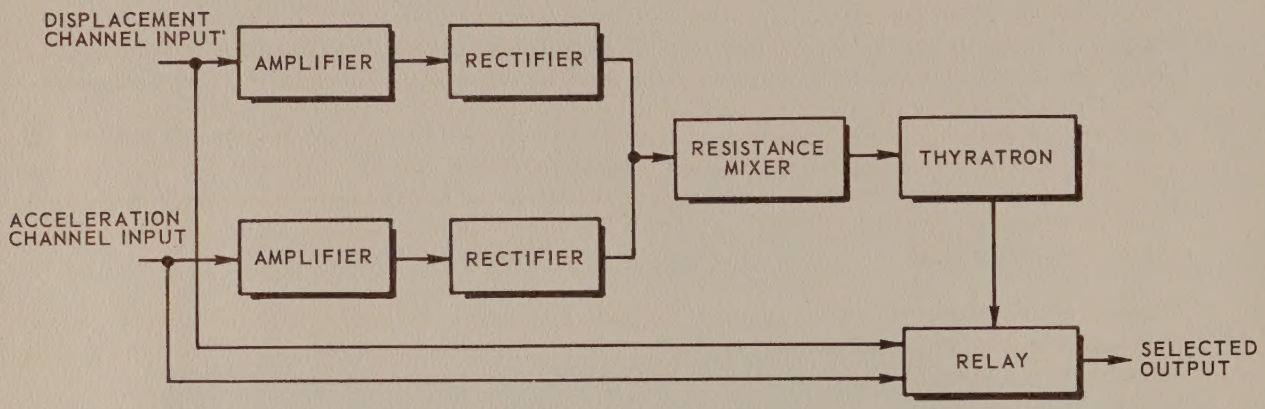


Fig. 3-1 Model DA-10 Control Selector, Block Diagram

3-2. CIRCUIT DESCRIPTION (See schematic 4176 or 4331)

a. The complete schematic of the DA-10 is shown in the accompanying schematic at the rear of this manual (4176 for the DA-10B and 4331 for the DA-10C). Input signals enter the two channels from terminals 6 and 7 for displacement and acceleration respectively; one or the other of these input signals is switched to the output, terminal 8, by relay K1. K1 is operated by thyratron V5 whenever the control grid voltage of V5 becomes sufficiently positive to cause the tube to fire.

b. Each voltage amplifier is stabilized by negative feedback, this is accomplished by using unbypassed cathode resistors in V1 and V2, and feedback resistors R9 and R18 in the D and G channels, respectively. The net over-all voltage gain of each amplifier is approximately 70. Output of each voltage amplifier is rectified by diodes, V3 for the D channel, and V4 for the G channel. The purpose of these channels is to control the energizing of relay K1.

c. The schematic shows that the polarity of voltage appearing across capacitors C7 and C8, for the D and G channels, is opposed (positive for the D channel and negative for the G channel). In each case, the magnitude of the voltage is proportional to the peak-to-peak value of the input signal, since the two halves of each diode (V3 and V4) act as a voltage doubler. During the negative half cycle of the input to the D channel, the signal at the plate of V1B is swinging negative; diode V3B conducts, charging series capacitor C3 to a polarity that is positive with respect to the plate of V3A. On the next half cycle, the signal at the plate of V1B adds to the voltage stored in C3, and diode V3A conducts, charging C7 positively with respect to circuit ground. In the G channel, the action is reversed and the voltage across C8 is negative with respect to ground. The voltages across C7 and C8 are combined in a resistance mixer; their net difference appears as control grid bias on thyratron V5.

d. The hold off grid of V5 is connected to a negative voltage; this voltage is obtained by placing a variable dropping resistor (R27) in series with the center tap of the power supply. The hold off grid of the 2050 is adjusted so the tube will fire with a grid voltage of zero volts plus or minus a very small differential. The tube will fire whenever the positive signal (proportional to the D channel input signal) exceeds the negative signal (proportional to the G channel input signal) by the differential voltage. This differential is due to the characteristics of the relay and thyratron V5 and is on the order of plus or minus 0.25 volts or less at the grid of V5. The gain of the amplifier reduces this to less than plus or minus 0.03 volts as seen at the D and G inputs.

e. The plate of V5 is connected to the secondary of power transformer T1, which produces an ac voltage of approximately 425 v rms with respect to the center tap. When the thyratron fires, relay K1 is energized. Current pulsations through K1 are filtered by capacitor C11. The Thyratron conducts only on the positive half cycles of voltage across T1; V5 will continue to conduct as long as the grid voltage is at a potential that allows the tube to fire. If the grid voltage decreases below the firing point, the tube will extinguish on the next half cycle of T1. The RC filter in the grid circuit of V5 slows the response time to prevent chatter and tripping on spurious signals or spikes of short duration, or due to feedback from the transients caused by the induction of relay coil K1.

f. A second set of contacts of K1 connect the indicator lights, IS2 and IS3, to the filament supply through a series dropping resistor to reduce their brilliancy; these indicate which signal is in control of the servo.

g. As bias resistor (R27) is turned clockwise, more resistance is placed into the circuit, so the hold off grid of V5 is increased negatively. The setting of R27 is a factory adjustment; it should not require readjustment in the field. The normal setting for R27 is 0.7 v rms (nominal), for each of the two input channels.

3-3. DA-10C MODIFICATION

In the majority of applications, the DA-10B selects the larger of two input signals in the manner described. There are cases where it is necessary for the DA-10 to select the smaller of two input signals. One such application is in the four level S-14 Servo System. This modified unit is called the DA-10C; the modification consists of reconnecting the relay contacts for both the selection circuit and indicator lights (all G connections to the relay are connected to the D connection and vice versa); this makes the channel switching opposite that of the DA-10B. The DA-10C schematic shows the relaxed (deenergized) position of the relay as being in the D position rather than the G position as shown on the DA-10B schematic. The remainder of the circuit and the operation is the same.

SECTION 4
MAINTENANCE

4-1. ANALYSIS

a. The first step in servicing a defective Model DA-10 is to localize the fault. Some faults, such as burned out resistors, arcing and shorted transformers can be located by sight, smell or hearing.

b. The following are a group of tests arranged to simplify and reduce unnecessary work and aid in tracing a trouble to a specific circuit or component:

(1). Visual inspection may disclose the trouble or determine the circuit in which the trouble exists.

(2). Voltage and resistance measurements will help to locate the defective component(s) when the readings are compared with the normal readings shown on the charts (see tables 4-2, 4-3 and figure 4-2).

(3). Trouble shooting symptoms are listed in paragraph 4-2 to aid in determining the defective part.

(4). Intermittent conditions should not be overlooked when conducting these tests. This type of trouble may often be made to appear by tapping or jarring the equipment.

4-2. TROUBLE SHOOTING (see figures 4-1 and 4-2)

a. The following procedures are meant to be a basic guide to the possible root of troubles encountered:

TABLE 4-1 TROUBLE SHOOTING

TROUBLE	LOCATION	CAUSE AND/OR REMEDY
The DA-10 does not come on when the power switch is turned ON.	Internal	Check for blown fuse (F1).
Blown fuse	Internal	Check for defective rectifier (V6). Check for shorted relay capacitor (C11). Check for shorted filter capacitors in the power supply.
Indicator lights do not light.	Internal	Check lamp bulbs in the indicators. Check wiring to the indicators.
No transfer, or the transfer is erratic.	Internal	Check for heater to cathode shorts in diodes V3 and V4. Check for open grid resistor at V5. Check amplifiers V1 and V2. Check power supply. Check for open BALANCE potentiometer (R27). Check for shorted capacitor (C15). Check for an open relay coil on K1. Check for excessive leakage in C7 or C8. Check for a defect in V5.

b. Voltage and Resistance Measurements

(1). Tables 4-2 and 4-3 list all of the voltages and resistances present on the DA-10B or DA-10C at the respective tube sockets and terminal numbers. Point to point measurements are made from ground.

(2). Measurements are taken with a 5000 ohm/volt meter on ac and a 20,000 ohm/volt meter on dc. Refer to Ling Schematics 4176 (DA-10B) and 4331 (DA-10C) for additional information.

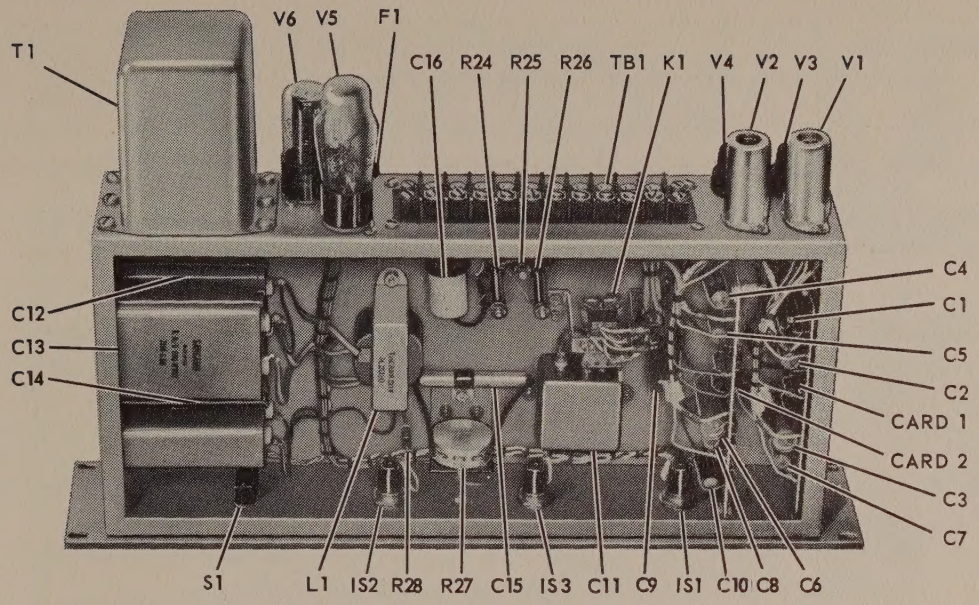
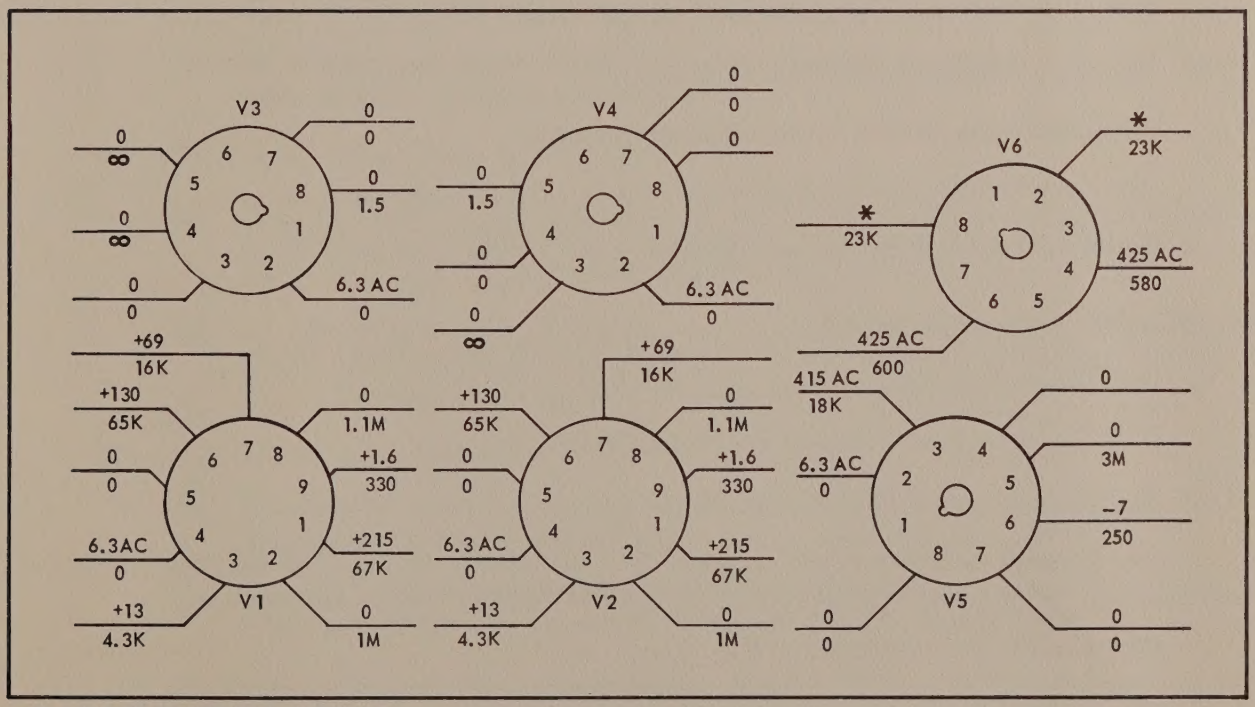


Fig. 4-1 Model DA-10 Control Selector, Bottom View



* 5.0 VAC FILAMENTS, +525 VDC

Fig. 4-2 Model DA-10 Control Selector, Voltage and Resistance Diagram

TABLE 4-2 MODEL DA-10 CONTROL SELECTOR, VOLTAGE CHECKS

TERMINAL NO.	1	2	3	4	5	6	7	8	9	10
TB-1	0	0	*	*	0	0	0	0	**	**

Jumper TB1-1 to 2 for the above measurements.
* 120 vac input.
** DA-10B – 6.3 volts, (selects D or G control) .20 Ω or ∞ , determined by K1.
DA-10C – 0 volts (Selects 0 ohms or ∞ , determined by K1.)

TABLE 4-3 MODEL DA-10 CONTROL SELECTOR, RESISTANCE CHECKS

TERMINAL NO.	1	2	3	4	5	6	7	8	9	10
TB-1	X	0	∞	∞	0	0	0	0	*	*

Jumper TB1-1 to 2 for the above measurements.
* DA-10B – 6.3 volts, (selects D or G control) .20 Ω or ∞, determined by K1.
DA-10C – 0 volts (Selects 0 ohms or ∞ , determined by K1.)

4-3. TEST EQUIPMENT

a. Variac, General Radio Model 6RWSM-T3 or equivalent.

b. Multimeter, Simpson Model 270 or equivalent.

c. Audio Oscillator, Hewlett Packard 202C or equivalent.

d. Distortion Analyzer, Hewlett Packard Model HO1 330B or equivalent.

e. Wattmeter, Triplett Model 660 or equivalent

4-4. TESTING AND CALIBRATION

a. Preliminary Connections

(1). Connect a jumper between TB1-1 and TB1-2.

(2). Connect an external ground to TB1-1.

(3). Connect the output of the Variac to TB1-3 and TB1-4; the Variac is then plugged into the Wattmeter which is plugged into 115 vac; the Variac should be turned off.

(4). Connect a dc voltmeter to V6-2.

(5). Connect an oscillator, with individual amplitude controls for each terminal, to TB1-6 and TB1-7. Some provision for metering both outputs should be made.

(6). Connect the Distortion Analyzer to TB1-8.

b. Electrical Tests

(1). Turn S1 ON and slowly increase the Variac to 115 vac. All tubes should light and the dc voltage at V6-2 should rise to approximately 540 vdc. The Wattmeter reading should not exceed 55 watts.

(2). Connect the Voltmeter to V5-6.

(3). Adjust the oscillator to 0.7 v rms on TB1-6 and TB1-7. Ensure that the inputs to TB1-6 and TB1-7 are identical. In this case it is recommended that TB1-6 and TB1-7 be jumpered and a common signal be used to supply both.

(4). Either IS2 (CONSTANT ACCELERATION) or IS3 (CONSTANT DISPLACEMENT) should be lit. Adjust R27 (BALANCE control) until one lamp goes out and the other one comes on. Note the position of R27. Adjust R27 in the opposite direction until the other indicator lights. Note the position of R27.

(5). Increase the input to TB1-6 and TB1-7 to 1.0 v rms. Repeat step (4). If the positions of R27 are appreciably different from those noted in step (4)., early overload or oscillation of the amplifiers is indicated. Try new tubes in V1 and V2 and repeat test.

(6). Remove the jumper from TB1-6 and TB1-7.

(7). Adjust the input to TB1-6 for 0.7 v rms; adjust the input to TB1-7 to 1.5 v rms.

(a). IS2 (CONSTANT ACCELERATION) on the DA-10B, should be lit and the input signal at TB1-7 should be present at TB1-8.

(b). IS3 (CONSTANT DISPLACEMENT) on the DA-10C, should be lit and the input signal at TB1-6 should be present at TB1-8.

(8). Decrease the input voltage to TB1-7 slowly.

(a). IS2 (CONSTANT ACCELERATION on the DA-10B, should go out and IS3 (CONSTANT DISPLACEMENT) indicator will light. Note the value of the input signal at TB1-7 . The input signal at TB1-6 should be present at TB1-8.

(b). IS3 (CONSTANT DISPLACEMENT) on the DA-10C, should go out and IS2 (CONSTANT ACCELERATION) indicator will light. Note the value of the input signal at TB1-7. The input signal at TB1-7 should be present at TB1-8.

(9). Increase the input voltage to TB1-7 slowly.

(a). DA-10B indicator IS3 (CONSTANT DISPLACEMENT) will go out and IS2 (CONSTANT ACCELERATION) indicator will light. Note the input voltage at TB1-7.

(b). DA-10C indicator IS2 (CONSTANT ACCELERATION) will go out and IS3 (CONSTANT DISPLACEMENT) indicator will light. Note the input voltage at TB1-7.

(10). The difference between the two input voltages required to effect the change-over noted in the above steps should be less than 0.06 volts; these two voltages should fall symetrically about 0.7 v rms (one should be below 0.7 volts by the same amount that the other is above 0.7 volts). Adjust R27 as outlined in the above steps until these conditions are met.

(11). The voltage at V5-6 should be between −5 vdc and −10 vdc.

(12). Adjust the input voltages for 1 v rms on TB1-6 and zero volts on TB1-7 and measure the power consumption; it should be approximately 55 watts.

(13). Disconnect the oscillator from TB1-6 and TB1-7. Connect a 47K resistor from TB1-6 to TB1-5. Connect a second 47K resistor from TB1-7 to TB1-5. The hum and noise level at TB1-8 should be 40 db or more below 1 volt; note any transients or spikes.

4-5. ADJUSTMENTS

Screwdriver adjustment R27 is normally set at the factory to provide the correct switching level, at around 0.7 v rms for each input; it seldom needs to be changed. The indicator lights on the front panel tell whether the DA-10 is switching to displacement or acceleration control of the servo.

4-6. CLEANING

The only cleaning necessary for the DA-10 is to keep the chassis free of dust. To clean the chassis use low pressure air, a vacuum cleaner or a soft brush to remove the dust.

4-7. OTHER DIFFICULTY

In the event of troubles or problems not covered by this manual, contact the factory, giving serial number, Ling number, conditions of use, and a full description of the problem. Ling field service personnel are constantly available for consultation on special problems concerning utilization or application of Ling equipment.

DA-10-B Schematic 4176F

www.manualsplus.com
1025635